

1. Introduction

Over the next decade, electric power plant operators may face significant requirements to reduce emissions of sulfur dioxide (SO₂) and nitrogen oxides (NO_x) beyond the levels called for in current regulations. They could also face requirements to reduce carbon dioxide (CO₂) and mercury (Hg) emissions. At present neither the future reduction requirement nor the timetable is known for any of these airborne emissions; thus, compliance planning is difficult.

Currently, different environmental issues are being addressed through separate regulatory programs, many of which are undergoing modification. To control acidification, the Clean Air Act Amendments of 1990 (CAAA90) required operators of electric power plants to reduce emissions of SO₂ and NO_x. Phase II of the SO₂ reduction program—lowering allowable SO₂ emissions to an annual national cap of 8.95 million tons—became effective on January 1, 2000.¹ More stringent NO_x emissions reductions are required under various Federal and State laws taking effect from 1997 through 2004. States are also beginning efforts to address visibility problems (regional haze) in national parks and wilderness areas throughout the country. Because electric power plant emissions of SO₂ and NO_x contribute to the formation of regional haze, States could require that these emissions be reduced to improve visibility in some areas. In the near future, it is expected that new national ambient air quality standards for ground-level ozone and fine particulates may necessitate additional reductions in NO_x and SO₂.

To reduce ozone formation, the U.S. Environmental Protection Agency (EPA) has promulgated a multi-State summer season cap on power plant NO_x emissions that will take effect in 2004. Emissions that lead to fine particles (less than 2.5 microns in diameter), their impacts on health, and the level of reductions that might be required are currently being studied. Fine particles are associated with power plant emissions of NO_x and SO₂, and further reductions in NO_x and SO₂ emissions could be required by as early as 2007 in order to reduce emissions of fine particles. In addition, the EPA decided in December 2000 that Hg emissions must be reduced; proposed regulations will be developed over the next 3 years. Further, if the United States decides that emissions of greenhouse gases need to be mitigated, it is

likely that energy-related CO₂ emissions will also have to be reduced.

Because the timing and levels of emission reduction requirements under the new standards are uncertain, compliance planning is complicated. It can take several years to design, license, and construct new electric power plants and emission control equipment, which may then be in operation for 30 years or more. As a result, power plant operators must look into the future to evaluate the economics of new investment decisions. The potential for new emissions standards with different timetables adds considerable uncertainty to investment planning decisions. An option that looks attractive to meet one set of SO₂ and NO_x standards may not be attractive if further reductions are required in a few years. Similarly, economical options for reducing SO₂ and NO_x today may not be the optimal choice in the future if Hg and CO₂ emissions must also be reduced. Further complicating planning, some investments capture multiple emissions simultaneously, such as advanced flue gas desulfurization equipment that reduces SO₂ and Hg, making such investments more attractive under some circumstances. As a result, power plant owners currently are wary of making investments that may prove unwise a few years hence.

In both the previous and current Congresses, legislation has been proposed that would require simultaneous reductions of multiple emissions. Several bills were introduced in the 106th Congress to address these issues: S. 1369, the Clean Energy Act of 1999, introduced by Senator Jeffords; S. 1949, the Clean Power Plant and Modernization Act of 1999, introduced by Senator Leahy; H.R. 2900, the Clean Smokestacks Act of 1999, introduced by Congressman Waxman; H.R. 2645, the Consumer, Worker, and Environmental Protection Act of 1999, introduced by Congressman Kucinich; and H.R. 2980, the Clean Power Plant Act of 1999, introduced by Congressman Allen.²

Additional bills introduced in the 107th Congress with similar goals include S. 556, the Clean Power Act of 2001, introduced by Senator Jeffords; H.R. 1256, the Clean Smokestacks Act of 2001, introduced by Congressman Waxman; and H.R. 1335, the Clean Power Plant Act of 2001, introduced by Congressman Allen. Each of the

¹Because power companies accumulated (banked) emissions allowances during Phase I of the program (1995 to 1999), the Phase II cap of 8.95 million tons per year will not become binding until the banked allowances have been exhausted.

²For more information on these bills see Energy Information Administration, *Analysis of Strategies for Reducing Multiple Emissions from Power Plants: Sulfur Dioxide, Nitrogen Oxides, and Carbon Dioxide*, SR/OIAF/2000-05 (Washington, DC, December 2000), pp. 1 and 2.

bills introduced in the 106th and 107th Congresses contains provisions to reduce power plant emissions of NO_x, SO₂, CO₂, and Hg over the next decade. The bills use different approaches—traditional technology-specific emission standards, generation performance standards, explicit emission caps with trading programs, or combinations of the three—but all call for significant reductions. In addition, the Bush Administration's National Energy Policy recommends the establishment of "mandatory reduction targets for emissions of three main pollutants: sulfur dioxide, nitrogen oxides and mercury."³ While differences exist on what the appropriate emission targets should be and how the program should be implemented, it is generally agreed that a more predictable emission reduction policy is worth pursuing.

The analysis described in this report was conducted at the request of the Subcommittee on National Economic Growth, Natural Resources, and Regulatory Affairs of the U.S. House of Representatives Committee on Government Reform.⁴ In its request the Subcommittee asked the Energy Information Administration (EIA) to "analyze the potential costs of various multi-emission strategies to reduce the air emissions from electric power plants." The Subcommittee requested that EIA examine cases with alternative NO_x, SO₂, CO₂, and Hg emission reductions, with and without a renewable portfolio standard (RPS) requiring a specified portion of all electricity sales to come from generators that use nonhydroelectric renewable fuels.

At the request of the Subcommittee, EIA prepared an initial report (referred to here as "the earlier EIA report") that focused on the impacts of reducing power sector NO_x, SO₂, and CO₂ emissions.⁵ The current report extends EIA's earlier analysis to add the impacts of reducing power sector Hg emissions and introducing RPS requirements. Expected costs to the energy sector and to consumers of meeting the specified emission caps and the RPS are examined (see Chapter 2 for a discussion of the specific scenarios prepared). The potential benefits of reduced emissions—such as might be associated with reduced health care costs—are not addressed, because EIA does not have expertise in this area. The bibliography for this report includes several studies that address the benefits of reducing emissions.

The analysis presented in this report should be seen as an examination of the steps that power suppliers might take to meet the emission caps specified in the Subcommittee's request for analysis. The specific design of the cases—timing, emission cap levels, policy instruments used, etc.—is important and should be kept in mind when the results are reviewed.⁶ For example, all the analysis cases assume that market participants—power suppliers, consumers, and coal, natural gas, and renewable fuel suppliers—would become aware of impending emission caps before their target dates and would begin to take action accordingly. If it had been assumed that market participants would not anticipate the emission caps, the results would be different. In an earlier EIA study that looked at alternative program start dates for imposing a CO₂ emissions cap (or carbon cap), an earlier start date and longer phase-in period were found to smooth the transition of the economy to the longer run target.⁷

This study is not intended to be an analysis of any of the specific congressional bills that have been proposed, and the impacts estimated here should not be considered as representing the consequences of specific legislative proposals. All the congressional proposals include provisions other than the emission caps and RPS requirements studied in this analysis, and several would use different policy instruments to meet the emission targets. Moreover, some of the actions projected to be taken to meet the emission caps in this analysis may eventually be required as a result of ongoing environmental programs whose requirements currently are not specified.

The purpose of this report is to respond to the Subcommittee's request; however, it also provides an important secondary benefit by establishing a framework for analysis that evolved in the research and modeling undertaken to complete the analysis.

During the course of this work, many choices had to be made about specific configurations for mercury mitigation technologies and their costs and performance characteristics; the response of fuels markets to much more stringent emission constraints; and the reaction of consumers to higher prices for electricity, coal, and natural gas. In an attempt to capture the uncertainties associated

³President George W. Bush, *National Energy Policy: Report of the National Energy Policy Development Group* (Washington, DC, May 2001).

⁴In the 107th Congress this subcommittee has been renamed the Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs.

⁵Energy Information Administration, *Analysis of Strategies for Reducing Multiple Emissions from Power Plants: Sulfur Dioxide, Nitrogen Oxides, and Carbon Dioxide*, SR/OIAF/2000-05 (Washington, DC, December 2000). See also J.A. Beamon, T. Leckey, and L. Martin, "Power Plant Emission Reductions Using a Generation Performance Standard," web site www.eia.doe.gov/oiaf/servicerpt/gps/gpsstudy.html.

⁶For a discussion of one possible alternative policy instrument, see the box on "Generation Performance Standards" on page 14 of the earlier EIA report. See also J.A. Beamon, T. Leckey, and L. Martin, "Power Plant Emission Reductions Using a Generation Performance Standard," web site www.eia.doe.gov/oiaf/servicerpt/gps/gpsstudy.html.

⁷Energy Information Administration, *Analysis of the Impacts of an Early Start for Compliance with the Kyoto Protocol*, SR/OIAF/99-02 (Washington, DC, July 1999).

with these choices, this report shows a wide range of cases with alternative assumptions for many of the major inputs. It would be impossible, however, to capture the full range of possible outcomes that could result from the policies examined in this analysis. Rather, this report should be seen as an indicator of a possible set of

energy market responses to multiple emission targets, providing a basic platform from which interested readers can obtain broad estimates of energy prices, supply, and demand in response to alternate sets of assumptions.

